A REVIEW PAPER ON: POWER GRID ASSOCIATED WITH WEB USING NON-CONVENTIONAL ENERGY SOURCE

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Abstract

This paper proposes a household power unit which is able to automatic switching and will communicate through Ethernet/Wi-Fiso utilization of the Non-conventional energy sources like solar energy will become more reliable. Further it will have made ready to end-user through electrical setup. The ARM processor is preferred to work as Embedded Device. The program loaded on this device will be work as Real time operating system. It is necessary to process, control and communication. Other services are provided on top of embedded device. It includes communication with server about the real-time information on energy meters at customer`s location. Real time energy source scheduling, energy source selection, power-up the connection and disconnection are some of the services that are provided through the online server system. The web browser available at authorities can act as an interface to these services provided. Impact on the operation of distribution feeders within the balancing areas of numerous electrical utilities is caused by the integration of distributed energy generation systems. Greater integration of renewable energy generation may be achieved by facilitating battery energy storage systems like integrating remote access to manage the set up like Ethernet, Web communication etc. The smart energy management of the resources is very important aspect. It allows collection of energy from multiple sources. The generated power at distribution level can be directly fed to the utility distribution network. In this paper, the smart energy management system is used where the dual battery monitoring system works alternately. ARM 7 microcontroller is used to regulate the actual operating function on the charger. It is ideally appropriate for residential premises along with commercial applications.

Keywords: *Embedded system with Ethernet, Server with Visual basic, Non-conventional Energysource etc.*

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1. INTRODUCTION

In present, we all are contributing to the carbon emissions of this planet earth cumulatively. Applications of non-conventional Energy Sources in domestic electric grid has always been the great effective method to minimize the proportion of carbon emissions. Global warming has raised because of these carbon emissions and depletion of the ozone layer. We can reduce carbon emission at individual level upon the environment by using alternatives like solar water heaters, solar cooker, bio-gas plant. But these solutions are dependent on location and climate. The restructuring the electrical setup of the entire home is a lengthy and expensive process for the residential user. The use of generated renewable energy can be efficiently utilized if the way to use the power supply of their homes will be as per necessary. The contribution among the total carbon emissions due to the power generation from conventional energy sources can be minimized by these alternative solutions.

Energy is the basic factor required for progressing the human life. The utilization of energy by the human beings for their needs is the dominant parameter used to measure the economic, social and industrial development ofa country. Energy demands for industrialization and transportation are increasing day by day as the population is increasing. It leads to energy crisis. To satisfy the world's growing demand is one of the society's foremost challenges. And solution is to discover the more non-conventional energy resources. Renewable energy resources are abundant in nature and low in cost. They also do not provide carbon emissions. We can contribute for stimulating the economy and providing job facilities by increasing the use of these non-conventional energy sources. It is concluded that solar energy is an efficient, safe and more secure way for generating and providing the clean energy.

The potential of renewable energy sources is large enough and they can meet demand of energy of the world many times. Renewable energy sources like wind, biomass, solar, hydropower, and geothermal can provide sustainable energy, based on the use of widely available, enough resources. Solar energy is available during day time only and solar irradiation levels are varying due to sun intensity, change in weather and also unpredictable shadows caused by clouds, birds, trees etc. The no. of power systems like PV/FC combined have been proposed and discussed. Because of relatively high cost compared with other traditional energy sources, many PV systems are not gaining popularity. Fuel cell cannot store energy. Also it has several shortcomings as slow response, it is difficult to cold start and its output fluctuates as the load gets vary. Since strong winds are mostly flow during nighttime. Wind power and battery are complementary to some extent. Because, battery has dynamic response and peak power capacity. It also enhances the power generation capability as it compensates the load by charging and discharging. Hence a hybrid generation system can offer high reliability to maintain continuous power output than any other individual power generation systems.

The user interface to the services available on web can provided by using embedded system for user which is able to communicate through Ethernet. The user can access the information from server through a web browser with an Ethernet connection.

This paper is arranged as further; the section I is about the introduction of the subject. Section II contains the Literature Survey which includes different relevant papers published before with their authors and publication details. In Section III, we describe block diagram if the whole system and its descriptions. The different hardware and components supports for collection of data from energy meters and communication. Data acquisition process to the embedded system as well as the module used to establish the Ethernet connectivity are described here. An analysis of the Embedded system used here, is presented in section IV. It also comprises the no. of services like authentication of user seeking to access the data collected, user interface, display the current power source and percentage of battery charge, power scheduling etc. Section Vis about future scope and scalability of the whole project. Finally, we given conclusion of our whole project in section VI.

2. LITERRATURE SURVEY

"Implementation of a Web of Things based Smart Grid to remotely monitor and control Renewable Energy Sources" by *Saswat Mohanty, Bikash Narayan Panda, Bhawani Shankar Pattnaik*- 2014 IEEE Students' Conference on Electrical, Electronics and Computer Science, 978-1-4799-2526-1/14/$31.00 ©2014 IEEE [1]

This paper describes a Smart Grid architecture implemented with the help of Web of Things. Web of Things comprise of a set of Web services provided on top of a number of Internet enabled Embedded devices. The Web browser on any computer can act as an interface to the services provided by these Web of Things. The Embedded devices are ARM Processor based devices with Ethernet capabilities. Real Time Operating System is used for process control on each of these embedded devices. Lw IP Protocol Stack is implemented on top of each of these devices so that IP connectivity can be established. The Web interfaces provide us real time information on each of the energy meters that are installed on site and communicate to the Embedded Internet devices using Ethernet communication protocol. Real Time energy source scheduling, energy source selection, power connection and connection are some of the services that are provided to an online authenticated user. [1]

Renewable Energy Sources and their usage in residential electrification has always been the most effective way to reduce the proportion of carbon emissions that we are cumulatively contributing the carbon release of this planet earth. Global warming has raised because of these carbon emissions and depletion of the ozone layer. We can reduce carbon emission at individual level upon the environment by using alternatives like solar water heaters, solar cooker, bio-gas plant. But these solutions are dependent on location and climate. The main power supply to our homes is looks like a primary source of energy for most of the domestic gadgets and appliances. The restructuring the electrical circuitry of the entire home is also a expensive and lengthy task for the end user. If the users are provided with an inexpensive process to configure the power supply of their homes as per requirement, the use of generated renewable energy can be maximized. This will significantly affect the total carbon emissions due to the power generation process from conventional energy sources. [1]

"The Internet of Energy: A Web-Enabled Smart Grid System" by *Nicola Bui, University of Padova and Patavina Technologies Angelo P. Castellani and Paolo Casari, University of Padova Michele Zorzi, University of Padova and Patavina Technologies* - IEEE Network •July/August 2012 0890 8044/12/$25.00 © 2012 IEEE [2]

The quest for sustainable energy models is the main factor driving research on smart grid technology. SGs represent the bridging paradigm to enable highly efficient energy production, transport, and consumption along the whole chain, from the source to the user. Although this concept promises to be very fruitful, the research on how to deploy it in the real world has just begun. A discussion on the enabling technologies for SGs and a possible roadmap for the fit able evolution thereof is the focus of this article. After introducing the recent trends that are pushing the SG paradigm, we will discuss various key scenarios for the SG, and briefly introduce some of its key requirements. We will then provide an analysis of how current and future standard solutions in the areas of communications and networking can be engineered into a system that fulfills the needs of the SG vision. We advocate the use of small, cheap, and resource-constrained devices with pervasive computing capabilities as the key component to deploy a ubiquitous energy control system. [2]

The energy generation scenario was started to changeover by different factors. At the end of 20th century, the shortage of the crude oil brought great efforts to research to new and non-conventional energy sources; the raising demand for energy called abrupt efficiency development in the energy generation and feeding processes, and new policy towards the environment changed the progress of many energy production firms. A more "green" friendly usage of energy resources is becoming an expected and profitable policy. In the energy market, the initial attempts of these policies will be considered as a model change. These days, scenario of single energy provider who offers the monopoly getting less preference by society. This market is suffering through the multiple transition stages involving different organizations. These are mostly the providers and vendors, and it is desired to make open approached model: customers should become energy producers at themselves. It is thankful to the availability and mobility of less expensive photovoltaic array and several reasonable sources of this energy which will be renewable. This resultant model of market is very dynamic in the transition point of view due to its distributive feature. This is becoming feasible because of the immediate availability of energy as it depends on wind, sunlight and other similar different sources. [2]

"A Novel Dual-Battery Energy Storage System for Wind Power Applications" by *Cong Long Nguyen, Student Member, IEEE, Hong-Hee Lee, Senior Member, IEEE* DOI - 10.1109/TIE.2016.2570721, ©2016 IEEE [3]

In this paper, a novel dual-battery energy storage system (DBESS) is proposed to firmly dispatch the intermittent wind power onto the grid with a lower system operation cost. Thanks to the DBESS, a wind farm can commit to integrating constant power in each dispatching time interval. In the proposed DBESS, the battery energy storage system (BESS) that takes the charged role is active when the dispatch power is lower than the wind power, and another is enabled if the dispatch power is higher than the wind power. [3]

"Determining the Power and Energy Capacities of a Battery Energy Storage System to Accommodate High Photovoltaic Penetration on a Distribution Feeder" by *Robert B. Bass, Member, IEEE, Jennifer Carr, Member, IEEE, Jose Aguilar, Student Member, IEEE, and Kevin Whitener, Member* - 2332-7707 © 2016 IEEE [4]

The integration of distributed energy generation systems has begun to impact the operation of distribution feeders within the balancing areas of numerous electrical utilities. Battery energy storage systems may be used to facilitate greater integration of renewable energy generation. This paper describes a method for determining the power and energy capacities a battery energy storage system would need in order to accommodate a particular photovoltaic penetration level within a distribution feeder, or conversely, the amount of photovoltaic that could be installed on a feeder with a minimal investment in power and energy BESS capacities. [4]

"Study of Bi-directional DC-DC Converter of Micro-Grid Hybrid Energy Storage System" by *Jin Li-jun, Yang Guang-yao, Jiang* - 978-1-4799-8389-6/15/$31.00 © 2015 IEEE[5]

Hybrid energy storage can take advantage of super capacitor's high power density and battery'shigh energy density. At the same time, hybrid energy storage cost less. So it's suitable for micro grid power balance control. This paper presents a main circuit structure which is Buck/Boost converters connecting super capacitor and battery with PWM (pulse width modulation) inverter to achieve bi-directional power adjustment and improve utilization of super capacitor. DC bus voltage is sensitive to and fluctuates with switching of PWM inverter's working conditions. [5]

"Smart Grid with Renewable Energy" by ***Mrs. N. V. Vader,*** Research student (Reg.141012208) JJT Univercity, Rajsthan Head of Elect. Power System Depart V.P.M.'s Polytechnic, Thane India ***Mr. Mandar V. Bhadang***, Lecturer, Electrical Power System Depart. V.P.M.'s Polytechnic, Thane, India published in Renewable Research Journal (Issue 1-2013) - JJT University and COSIA [6]

Every day, energy demands are raising and hence it causes unbalance in the current grid distribution which gives outcomes in several other undesirable situations like load shedding, fluctuations in voltage etc. So it affects the customers ultimately. The only solutions to avoid such all situations, is to serve the increasing the demand by present generation. Even we are behind the expectation in case of the conventional energy sources. And hence, by producing more power is not sufficient by conventional ways also. Therefore, the application of mon-conventional energy is most important. The amount of solar power spread over the surface of the earth is approximately about 86 k Terra Watt. It covers only 0.22% of our planet by solar panels and collectors. It has efficiency about 8%, it would be enough to satisfy the current global power consumption. Solar power has huge potential for satisfying the increasing energy needs of world. And smart grids facilitate the efficient operation of the grid distribution system. "Smart" grids which uses the data and communication technologies, so it makes the electric power systems to be more efficient and reliable, further it is adopted by power industry. Available energy resources are efficiently utilized by the new technology. Combine applications of upper levels of non-conventional energy and conventional energy sources are becoming possible because of these technologies. We are unable to control the power output of these renewable sources; hence these are not 'dispatch-able'. In the next few decades, Sustainability of the energy in future heavily depends on the way of addressing the problem of the renewable energy.

Though the production of power in India has increased and improved in previous years, but there is consistency in demand and we are lagging out of supply. Also high shortages of energy are faced in these years. Lots of skills set are requiring, so the Smart grid and renewable energy can be integrated into a system. These skills will include skill to solve the general problems, process of interfacing of different module, make use of advanced technology etc. The new problems are challenging and system integration puts it all together by the large variety of engineers.[6]

3. BLOCK DIAGRAM AND DESCRIPTION

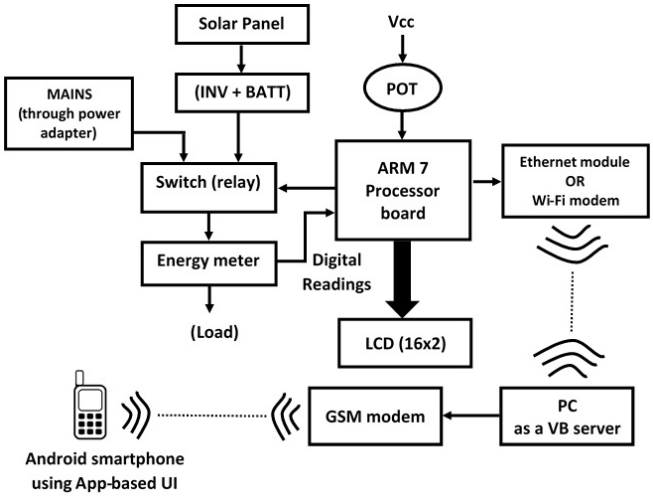

Fig -1 Block diagram of the system

Power grid architecture presented above has two energy inputs. The first is conventional energy source which is typically the mains that left most of the carbon emission residuals within the environment. The conventional energy sources include the Atomic Energy, Steam-turbine power, Thermal power plants etc. The another kind of energy source may consist of number of renewable energy sources which are environment friendly. Our aim is to increase the utilization of these renewable energy sources. Energy derived from bio-fuel and energy from Wastes, wind turbines, solar panels, biogas plant, these are well-known non-conventional energy sources. The data collection of digital meter is received and processed by embedded systems which are communicating consistently with the meters. The periodic collection of data from the digital meter is updated into an embedded system. The web services will be serviced further, are based on the embedded system. The services provided by the server includes percentage battery charging, display of current energy source, meter information on LCD screen, it communicates through the network with data available in memory. It will control energy sources by switching the source by embedded system from other location. The sources are switched between non-conventional source to mains by embedded device as per the need arises. The embedded device waits for the command from the server as it is enabled with the network connectivity. It is operated by an authenticated officer to switch between the energy sources and other control actions.

A username and password are need to be entered by user/authorities/operator to gain access to these services. It can be done from workstation/computer connected to the net work. In case of multiple homes or power grid architecture, the switching between the energy sources for each home is carried by using relay logic. Embedded device will control these relay circuit.

Hardware Units

1. Non-conventional Energy Sources: We are preferring a non-conventional energy source, it's a solar panel is there to supply clean energy and to charge the battery.

2. Electrical Setup: It consists various circuits like battery, inverter, switch etc. Initially output from energy sources is fluctuating and it needs to be stable so battery will properly charge. The Embedded system and few others will require DC power to function. The DC power supply is separate unit which has input from mains. Battery is attached to output of charge controller to supply DC power in case of failure of energy sources. Inverter is there to gain AC output from DC input signal to supply further public grid. When the both energy sources are not able to supply necessary amount of energy or in case of maintenance, the public grid is switched to mains. For this, we are preferring the relay logic circuit.

3. Power Grid at Customer Premises: On the other side, public connections are taken from the switch output. Subscriber can get and use supplied energy by placing digital static energy meter. The digital readings are forwarded towards web server which an embedded device unit.

4. EMBEDDED SYSTEM

4.1 ARM Processor

In this setup, an embedded system is designed by using ARM processor and its preferred to work as Ethernet Enabled Embedded Device. The program loaded on this device will be act as Real-time operating system. It is necessary for processing as well as control and communication. The LPC2148 are based on a 16/32 bit ARM7 TDMI- CPU with real-time emulation and embedded trace support, together with 128/512 kilobytes of embedded high speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. 32-bit timers, 4- channel 10-bit ADC, USB PORT, PWM channels and 46GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of-sale. With a wide range of Ethernet communications interfaces, they are also very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.

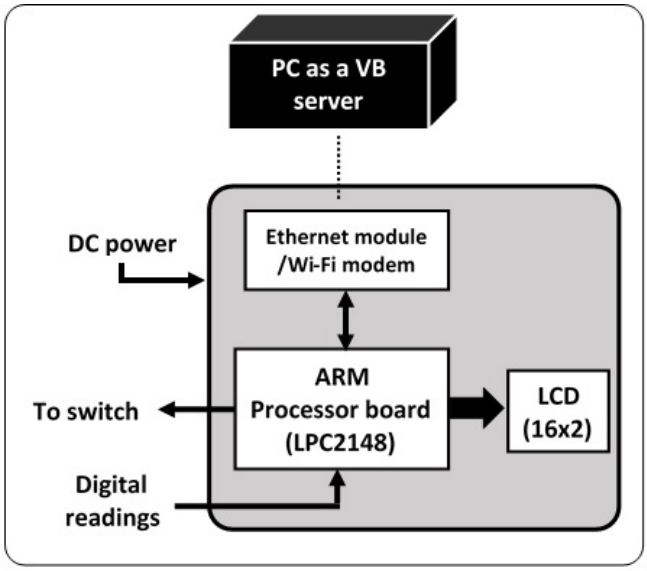

Fig-2 Embedded system

4.2 Serial Communication with Energy Meters

The micro-processor or CPU communicates with serial port by interfacing its UART.

4.3 Ethernet Port on Embedded System

The RJ45 port will be available which will act as Ethernet port and it is attached to the ARM processor in order to established a local network connection.

This will take placed in three steps:
1) Setup the Ethernet connection
2) When the need arises, it will connect to the Ethernet
3) Terminating the connection when there is no more required to transfer data or receive data through Ethernet.

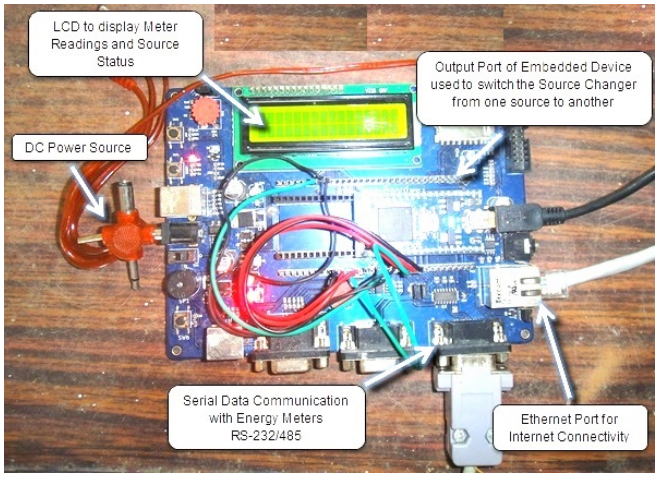

Fig-3 ARM processor board and Ethernet connection

4.4 User Interface

A User Interface is designed in graphical form and it is provided to the user by using visual basic. It will be operated on computer connected to the Ethernet. The user may be subscriber, operator or any authority. The user is authenticated after he/she registers himself/herself for a connection. This can be done on the login screen.

These options available at this user interface are like power units consumed by subscriber, current energy source and other parameters. This helps to analyze the his/her energy needs and he/she can plan the scheduling of his/her power sources as per the his/her needs. He/she can learn his/her power usage such as daily use, monthly usage or yearly usage. The data can be compared to consumption of different times of energy sources.

Software Requirements

- Keil µVision: Used for programming in Embedded C.
- Visual Basic for GUI
- Proteus: Used for simulation purpose
- Flash magic: to download the code in MCU

Hardware Requirements

- ARM LPC2148
- LCD (16x2) – HD44780U
- Relay module as Switches
- Inverter with battery
- Ethernet module/Wi-Fi modem
- Solar Panel

Advantages

- Easy to Maintenance
- Reduces Electricity Bills,
- Low Maintenance Costs
- Technology Development
- Less Power Consumption

5. FUTURE SCOPE

The presented model is reliable to build up on existing meters installed at residential locations. The whole set up can be developed with the electrical components and these can be choosed according to size of the project. So it will be a cheaper installation on a country side region. It can be expanded up to a large scale project with high security. Now days, most services are made available through the Web, the operations and procedure scan be reconfigured from remote and it depends on requirements and feedback from user side. The additional services can be managed frequently at the time when the necessary is there.

6. CONCLUSION

The described system can be easily build up and it is also scalable according to requirements. It gives an effective way to use our renewable energy sources. It has been underutilized otherwise. We can conclude that; it gives very efficient techniques for deploying green energy concept on a scale which may vary from domestic applications to industrial. The integration of Ethernet with existing architecture of subscriber power grid will offer lots of opportunities to us for advancements in our techniques to save energy.

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